REMARKS

Claims 1-9, 12-17, 19-31, 34 and 35 are pending in this application. Applicants have amended each of the pending independent claims to specify that a precursor having a carbon-carbon triple bond is used. Claim 18 has been canceled.

35 U.S.C. § 103 Rejections

Claims 1-9, 12-16, 18-31 and 34 are rejected as being obvious in view of U.S. Patent No. 7,064,088 to Hyodo et al. ("Hyodo"). Claims 17 and 35 are rejected in view of Hyodo in combination with U.S. Patent No. 7,087,271 to Rhee et al.

All pending claims recite the use of a carbon-carbon precursor and dual source plasma generator to produce dielectric films having low stress and low dielectric constant. Specifically, the claims recite deposition of a film having a dielectric constant of less than 3.0 and a residual stress of less than 35 MPa.

In rejecting these claims over Hyodo, the Examiner has contended that although Hyodo does not specifically teach low stress films having a dielectric constant of less than 3.0, because Hyodo teaches deposition of low stress films having dielectric constants of "less than 4," the present claims are prima facie obvious over Hyodo.

As described below, Applicants are submitting a Declaration by Dr. Gordon Wu and experimental evidence that the methods in Hyodo do not result in the claimed properties. Specifically, constant with the disclosure in Hyodo, the experimental evidence shows that the precursors used in Hyodo produce low stress films having k values between 3 and 4, and not below 3 as recited in the instant claims.

The pending claims

Prior to Applicants' invention, low k films (k<3.2), including CDO films, had a stress in excess of 50MPa. The residual stress of CDO films produced under unoptimized process conditions is generally >50 MPa with a typical value in the range between 60MPa and 90MPa. Embodiments of the invention significantly lower residual film stress by appropriate precursor selection and optimizing deposition process conditions.

Specifically, Applicants found that both using a C≡C triple bond and silicon containing precursor such as TMSA ($(H_3C)_3Si\text{-}C{\equiv}CH$) and BTMSA ($(H_3C)_3Si\text{-}C{\equiv}C\text{-}Si(CH_3)_3$) and using a dual source electrode with different frequencies to deposit a CDO film are critical in obtaining films with low dielectric constant and low magnitude of stress.

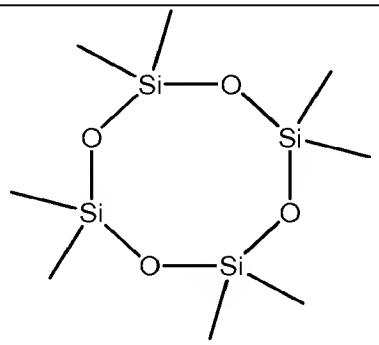
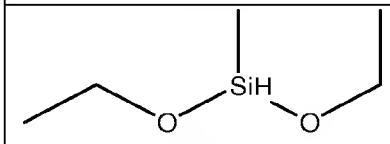
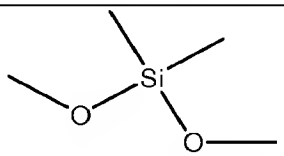
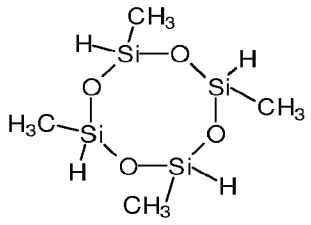
Hyodo describes depositing films using precursors of the formula: $Si_nO_nR_{2n-m}$, $(Si_nO_nR_{2n-m})X_m$ (n is integer of 3-6) and $Si_\alpha O_{\alpha-1}R_{2\alpha-\beta+2}X_\beta$ (α, β = 1-3), with the R and X groups are alkoxy, vinyl, amino and acid radical groups.

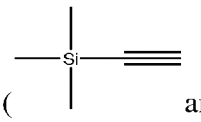
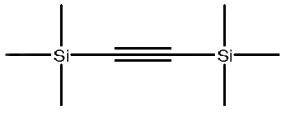
Applicants have repeatedly argued that while Hyodo shows that these films may have compressive stress at dielectric constants between 3 and 4, it does not show that these films have dielectric constants of less than 3, as claimed.[1]

In further support of this position, Applicants refer to the Declaration of Dr. Qingguo Wu and the experimental data in the attached Appendices. The data shows that the $Si_nO_nR_{2n-m}$, $(Si_nO_nR_{2n-m})$ and $Si_\alpha O_{\alpha-1}R_{2\alpha-\beta+2}X_\beta$ compounds in Hyodo do not produce films having the claimed properties.

In Appendix A, films deposited using C-C triple bond containing compounds BTMSA and TMSA (as claimed) were compared to the following $(Si_nO_nR_{2n-m})$ and $Si_\alpha O_{\alpha-1}R_{2\alpha-\beta+2}X_\beta$ representative of the compounds disclosed in Hyodo:

[1] Specifically, as described in previous responses, the k-values that Hyodo discloses achieving for its hard film are "less than 4," but none are close to Applicants' claimed limitation of no more than 3. Specifically, Hyodo discloses hard film k-values of 3.5, 3.4, 3.5 and 3.3 in Examples 1-4, respectively. This disclosure in Hyodo does not reasonably teach or enable one of skill to make a low stress film having a dielectric constant of less than 3.0. Applicants also submit that MPEP 2144.05, which deals with overlapping *ranges*, is not applicable in this instance. Note that all of the case law cited in Section 2144.05 has clearly demarcated ranges. Hyodo does not disclose a range but only a maximum value, i.e., 4. Even if one were to impute a lower end to this range, it would not be lower than 3.0, given that the *lowest* value Hyodo shows is 3.3.

Compound	Formula; citation in Hyodo	Stress for films with k < 3
 octamethylcyclotetrasiloxane	$Si_nO_nR_{2n-m}$; n=4; m=0 Specifically cited in Hyodo at col. 4, line 25 and in Example 3	Greater than 40 MPa
 diethoxymethylsilane	$Si_\alpha O_{\alpha-1}R_{2\alpha-\beta+2}X_\beta$; α=1, β = 2, R=H, CH3, X=ethoxy	Greater than 40 MPa
 dimethyldimethoxysilane	$Si_\alpha O_{\alpha-1}R_{2\alpha-\beta+2}X_\beta$; α=1, β=2, R=CH3, X=methoxy Specifically cited in Hyodo at in Examples 1 and 3	Greater than 40 MPa
	$Si_nO_nR_{2n-m}$; n=4; m=0; R=H, CH3	Greater than 40 MPa

None of the compounds are able to produce films having stress lower than 40 MPa and k <3. This compares to Applicants' methods, using TMSA and BTMSA ( and  , respectively), for which tensile stress of less than 40 MPa, and in some cases of less than zero (i.e., compressive stress), are obtained. Thus, as seen in Appendix A, and explained in the Declaration of Dr. Wu, in the range of k<3, only the C-C triple bond containing

compounds had compressive stress values or even tensile stress values below 35 MPa. Note that this is consistent with the data in Examples of Hyodo, which show that all films having compressive stress have dielectric constants of greater than 3, specifically, hard film k-values of 3.5, 3.4, 3.5 and 3.3 in Examples 1-4, respectively. Appendix B compares stress of a precursor containing a vinyl group (vinyl-tetramethylcyclotetrasiloxane or VTMCTS) with that of BTMSA and provides evidence that the C-C triple bond is critical in obtaining low stress films.

For at least the reasons given above, Applicants submit that the claims are patentable and request that the rejections over Hyodo be withdrawn.

Conclusion

Applicants believe that all pending claims are allowable and respectfully request a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below. If it is determined that any additional fees are due, the Commissioner is hereby authorized to charge such fees to Deposit Account 504480 (Order No. NOVLP091).

Respectfully submitted,

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